INTERACTIVE SOFTWARE: MeshTools

ISE-MeshTools Tutorials

Tutorial 03 : working with projects

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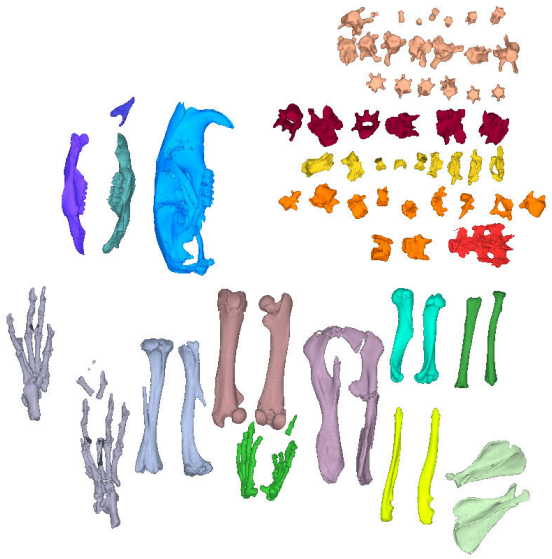

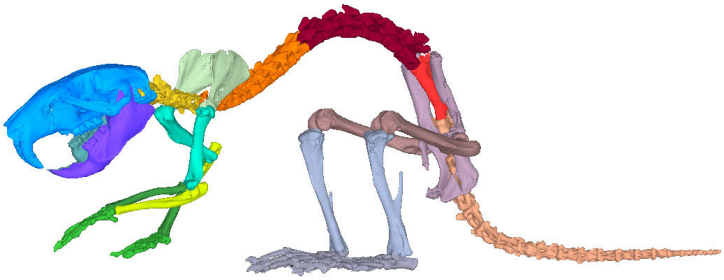

Tutorial 03 includes:

- A series of 74 .vtk surface files, each representing a bone belonging to *Canariomys bravoi*
- Two series of 74 .pos files
- One .ori file
- Two .ntw files
- The present .pdf document

Working with projects

Contents

1. About the present reconstruction

1.1 About the specimens

The present three-dimensional reconstruction of the skeleton of the giant rat of Tenerife (Canary Islands, Spain) was obtained by computerized microtomography reconstruction. Two distinct specimens were used in this reconstruction, TFMCV872 and TFMCV873 (Museo de la Naturaleza y el Hombre, Santa Cruz). TFMCVF872 is an almost complete but disarticulated skeleton of *C. bravoi*. As mandibles and skull of this specimen were not well preserved, a complete cranium of *C. bravoi* (TFMCVF873) was added to this reconstruction.

1.2 Completeness

Murinae rodents observed by Owen (1853) always possess a total amount of 19 thoraco-lumbar vertebrae, most often divided in 13 thoracic and 6 lumbar vertebrae (he also observed at least one specimen of *Rattus norvegicus* possessing 12 thoracic and 7 lumbar vertebrae). This number of 19 thoraco-lumbar vertebrae is observed very often in mammals and is thought to be a plesiomorphic condition for eutherians and metatherians mammals (for a review, see for instance Sánchez-Villagra et al., 2007). The present fossil of *C. bravoi* exhibits a number of 17 thoraco-lumbar vertebrae, so there is a high probability that 2 vertebrae (either 1 thoracic and 1 lumbar, or 2 lumbars) are missing. Furthermore, the number of caudal vertebrae in Murinae rodents observed by Owen (1853) is often greater than the 21 presented in this reconstruction The present reconstruction of *Canariomys bravoi* does not take into account these potentially missing thoraco-lumbar and caudal vertebrae, and you may propose a new reconstruction based on your own observation or Murinae rodents.

2. Tutorial

Before using this tutorial, please download and read ISE-MeshTools User Manual.

2.1 Download and unzip files

Download and unzip the 3D files associated to this tutorial in a folder containing no accent. Open ISE-MeshTools. Also, make sure that the path leading to the folder containing the tutorial files does not contain any accent. Otherwise, ISE-MeshTools will not be able to open the contained files.

2.2 Opening surfaces

2.2.1 Opening surface files individually

You may load the files one by one (File -> Open Surface, then select one of the 74 .vtk files present in the tutorial folder). When loaded this way, the corresponding opened surface object is drawn grey, which indicates that this object is selected. You may interact with selected objects in different ways (see ISE-MeshTools manual for further explanations). Here, you may for instance change the position of a selected object by loading a .pos file (Fil -> Open Position). For a given bone, you may choose any of the available .pos files, but it is advisable to choose one of the two related to the bone you just opened. In this tutorial, the .pos files are named the following way: Bone_name_initial_position.pos or Bone_name_anatomical_position.pos. See ISE-MeshTools manual for further explanations regard-

ing how .pos files are constructed and how they can be modified manually. You may unselect all opened objects by pressing “CTRL +D”, or selecting all objects by pressing “CTRL +A”. You may delete all selected objects by pressing “Del”.

2.2.2 Opening a project file

First, delete all opened objects (press “CTRL+A”, then press “Del”). Then open one of the two available project files (File->Open Project). Choose either “initial_position.ntw” or “anatomical_position.ntw”. Once loaded, the 74 surface file objects are opened, are given a position and a colour. When opening “initial_position.ntw”, each bone is given the position described in the file Bone_name_initial_position.pos; when opening “anatomical_position.ntw”, each bone is given the position contained in the file Bone_name_anatomical_position.pos. The colour associated to each bone is defined in the chosen .ntw file. Note that all newly opened surfaces are unselected.

2.2.3 Canariomys .ori file

The present tutorial contains a .ori file, which contains orientation labels for the coordinate system orientation helper. You can load this file the enclosed .ori file (File->Orientation labels, then select “Canariomys.ori”). Once loaded, the system coordinate orientation helper will show the following labels :

+z axis : dorsal
-z axis : ventral
+y axis : left
-y axis : right
+x axis : proximal
-x axis : distal

You may set your own orientation axis labels with the “Edit orientation labels” window (Viewing opt.-> Orientation labels)

2.3 Camera field of view depth and clipping plane

First, delete all currently opened objects (press “CTRL+A”, then press “Del”), and open “anatomical_position.ntw” (File->Open Project). When rotating the camera, a part of the reconstruction of *Canariomys bravoi* becomes hidden (either the tail, or a part of the head).

2.3.1 Editing the depth of the field of view

The present reconstruction of *Canariomys bravoi* is approximately 300 mm long. On ISE-MeshTools startup, the depth of the field of view is 200 mm. Depending on the parameters of the camera (zoom, depth of the field of view and position of the clipping plane), a part of the reconstruction may be hidden.

There are several ways to change this :

- When the option “Keep current field of view depth” in the General options window (show->General Options -> Depth of field of view panel) is active, changing the zoom will not affect the camera.far (depth of the field of view) and camera.tz (position of the clipping plane) values. In that case, you

may need to edit manually the depth of the field of view in the Camera option file (Viewing opt. -> Camera -> Camera options : change for instance “Camera far” control to 600 mm, instead of 200and “Tz” to -300). Note: when working with large objects (= more than 10 cm long once), it is advisable to increase the default “Camera far” value.

- When the option “Adapt field of view depth” is active in the General options window (show->General Options -> Depth of field of view panel), changing the zoom value will also modify the depth of the field of view (camera.far value) and the position of the clipping plane (camera.tz value).In that case, depending on the zoom level, you can obtain a complete view of the reconstruction withouth having to change manually other camera parametrs.

Also, the buttons  and  which lie just underneath the clipping plane slider (and also in the camera option window) permit to adjust / readjust the position of the clipping plane at predefined positions :

-  : the clipping plane is placed at z = 0 (all objects having a z coordinate along z viewing axis smaller than 0 are hidden).

-  : the clipping plane is replaced at its original value : z= - camera.far / 2. This value permits to view objects having positive and negative coordinates along z viewing axis.

To modify the position of the clipping plane, you may also move the “clipping plane slider” laying in the upper part of the right panel of the main window.

2.3.2 Editing the clipping plane

Also, depending on the “z” position of the camera, some objects are hidden. You may modify the “z” position of the camera manually (Viewing opt. -> Camera -> Camera options: change “Tz” control) or interactively (move the “cp” control = clipping plane slider laying centrally in the right panel of the main window). See ISE-MeshTools User Manual for further explanations.

Increasing Tz will tend to hide objects which lay close to the camera (user’s point of view), and will tend to show distant objects. Decreasing Tz will tend to show objects lying close to the camera (user’s point of view), and will tend to hide distant objects.

For instance, a Tz value of 0 means that all the objects situated before the origin (x=0;y=0;z=0) are hidden, and that only the objects situated between the origin and “Camera far” are displayed.

A Tz value of -100 (default value) means that all the objects situated more than 10 cm before the origin (x=0;y=0;z=0) are hidden, and that only the objects situated between -100 and -100 + Camera far are displayed.

2.4 Object manipulation

First, delete all opened objects (press “CTRL+A”, then press “Del”). For instance, open “initial_posi-

tion.ntw" (File->Open Project). You may wish to displace one or more objects at once. To know how to select one or more than one object and to displace/rotate selected objects, please read the "Interaction modes", the "Keyboard and mouse controls" and the "Camera and object GUI main controls" sections of ISE-MeshTools User Manual.

2.4.1 Positioning groups of objects

When rotating a group of selected objects, rotation is achieved around the centre of mass computed on all selected objects. For instance, if you have managed to position the bones belonging to the right forelimb of C*anariomys bravoi* in anatomical connexion after displacing each bone one by one, in a second time, you may select all these bones and displace/rotate the whole forelimb in relation to the other parts of the reconstruction.

2.4.2 Renaming objects

In some cases, you may need to rename some objects. For instance, you may disagree with our interpretation of which vertebra is the last thoracic one, and which is the first lumbar one. To change the name of one bone, select one (and only one) surface, click on  and change the "label" field in the "Edit Name" window.

2.5 Saving projects

Select all the objects you with to save and go in "File->Projects->Save Projects". Though ISE-MeshTools can open .ntw files implicating .stl, .ply and .obj surfaces, when saving a .ntw project, surface files will be saved in .vtk format in order to keep potential tag / scalars associated to each saved surface. Each surface file will be given the name of the original file. Each position file will be given a name which starts with the name of the associated surface and ends with the name of the project. The advantage of naming position files that way is you may propose different reconstructions of *C. bravoi* using this single set of 74 surfaces.

Please note that all selected surfaces saved via this option need to have distinct names. For instance if you have renamed bone objects, you have to make sure that all (selected) objects have distinct names. Surface files will be saved in the same folder as the .ntw files.

3. Acknowledgements

I am grateful to María Esther Martín González, curator of the Museo de la Naturaleza y el Hombre, Santa Cruz, for her enthusiasm regarding the diffusion of the present tutorial. I thank Franck Guy (IPHEP), who performed the CT scan of TFMCV872, and the MRI imaging platform for the access to imaging facilities. The present reconstruction was initiated by Mikael Antocio during the academic year 2010–2011, at the Paleontology Department, University of Montpellier-2. Thanks to Lionel Hautier (ISE-M) for his helpful expertise regarding mammalian vertebral anatomy.

4. References

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